Topic: Antenna designs for the Mars Exploration Rover Spacecraft, Lander, & Rover

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Abstract: In May – July 2003, two twin spacecraft will be sent to Mars each carrying a powerful new Mars rover. These robotic explorers are "big sisters" to the 1997 Mars Pathfinder rover and will carry a sophisticated set of instruments that will allow them to search for evidence of liquid water that may have been present in the planet's past. The rovers will be identical to each other, but will land at different regions of Mars.

One of the objectives for the spacecraft design and operations is to maintain a communications link with the spacecraft-lander-rover throughout all phases of the mission, from post launch, through cruise, and particularly throughout the critical entry, descent & landing phases. This will enable mission planners to monitor the spacecraft health during important maneuvers and should there be a fatal or mission limiting spacecraft event, be able to reconstruct the state of the spacecraft, thus providing important engineering data that can be used for future missions. Providing the required coverage for this mission requires the use of a fairly large complement of antennas including, X-band cruise stage medium gain and low gain antennas, an X-band antenna for use during hypersonic entry, an X-band & UHF antenna for use during landing, and an X-band link to Earth for pre-rover deployment communications. Following landing the rover is deployed and a set of three antennas are used to provide communications with the Earth and a Mars orbiter, an X-band High gain antenna (direct to Earth), an X-band low gain antenna (direct to Earth) and a UHF antenna (link to Earth via a Mars orbiter).

The complexity and packing density of this spacecraft-lander-rover presents a number of challenges requiring a great deal of ingenuity and a fair amount of compromise with regard to the final antenna designs. The resulting antenna subassembly represents a workable solution to an aggressive spacecraft assembly configuration and set of mission operation objectives.

Biography: Dr. Joseph D. Vacchione was born in Newport, RI on October 1, 1962. He obtained a B.S. in Electrical Engineering from Northeastern University, in Boston, MA in 1985, and a M.S. & Ph.D. from the University of Illinois, Champaign-Urbana in 1990. Since graduation, he has been with the Jet Propulsion Laboratory in Pasadena. As a senior member of the technical staff, Dr. Vacchione has been the lead antenna engineer for the Mars Pathfinder mission, the Shuttle Radar Topography mission (SRTM), and the Mars Exploration Rover Mission.